Gamma-Ray Scan of the Fansteel Site

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Prepared for Greg Fife, OSC, Region 6

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I. Introduction

In the spring of 2019, the USEPA National Center for Radiation Field Operations (NCRFO) located in Las Vegas, NV was contacted by the EPA Region 6 office concerning the Fansteel Site, located in Muskogee, Oklahoma. The Fansteel Metals/FMRI Site is located at 10 Tantalum Place in Muskogee, Muskogee County, Oklahoma. The site is located on the northeast corner of East Shawnee Avenue (US-62) and Muskogee Turnpike (OK-165). The site geographic coordinates are Latitude 35.77388° North and Longitude 95.305086° West. Figure 1 shows the location of the site.

Fansteel operated a metal processing facility which produced tantalum and niobium metal products from 1957 to 1989. The raw material (ore) used for tantalum and niobium production contained uranium and thorium as naturally occurring trace constituents. The concentrations of natural uranium and natural thorium were sufficient to cause the ores and slags to be classified as source materials by the Atomic Energy Commission, which originally issued License No. SMB-911 in 1967 to Fansteel, Inc.

EPA Region 6 is performing an Expanded Site Inspection (ESI) to collect the data necessary to determine if the site presents a threat to public health or welfare of the United States or the environment in accordance with 40 Code of Federal Regulations (CFR) 300.415. NCRFO was asked to contribute to the dataset by collecting gamma-ray measurements at or near settling ponds and other site locations as determined by the regional On Scene Coordinator. The dataset will assist the region in identifying possible anomalous locations that may warrant further radiologic investigation.

In July, 2019, personnel from NCRFO conducted qualitative gamma survey scans at the Fansteel Site using the NCRFO Environmental Radiation Buggy Scanning System.

II. Objective

The project objective was for NCRFO personnel to perform qualitative gamma-ray surveys of specific site locations as determined and communicated by the Region 6 OSC. A preliminary review of the data was performed by the Project Lead to identify locations of anomalous readings.

Data files (such as qualitative total gamma counting rates, spectra, time stamps, and location coordinate information [GPS]) will be provided to the region by NCRFO that can be readily plotted in a GIS map format to show scan plots and relative ground activities.

III. Methods and Materials

The Environmental Radiation Buggy Scanning System consists of a gamma-ray detector, GPS, WiFi and cellular internet capabilities mounted on a spoke-wheeled runner's baby cart for use in rough terrain or around obstacles that would preclude other modes of high-efficiency gamma-ray scanning.

A single Radiation Solutions Incorporated (RSI) RSX-1 detector is mounted on the bottom of the buggy parallel to the ground. It contains a 4" by 4" by 16" sodium iodide scintillation crystal and associated electronics. The detector is connected to an RSI RS-701 console interfaced to a high accuracy GPS receiver/antenna and WiFi router that is internet capable. Power is provided by a motorcycle battery also mounted on the cart. The detector is unshielded providing an unimpeded field of view of the surrounding ground.

Scanning is performed at speeds of about 2 mph. The system is controlled with the RSI RadAssist software and a "breadcrumb" map of the scan footprint can be monitored with the RSI MapAssist software. Scan data is collected on-board or remotely on an accompanying PC or retrieved from the RS-701 console onto a USB thumb drive. A live spectral output is observable during the scanning process or can be duplicated during a replay of scan data. The software displays second-by-second spectra of the RSX-1 detector in a "waterfall" progression format.

IV. Buggy System Operations

Daily background measurements were performed to reflect changing environmental conditions such as changes in soil moisture content. The background location was the front gravel and dirt parking lot of the site Research and Development Building from which operations were conducted (see Figure 2). The background location had already been identified and utilized by site employees for their instrument checks.

Quality control checks were performed both before and after operational periods to ensure that detector count rate and full-width-at-half-maximum values (FWHM) stayed within 20% from beginning to end of each operational period, as specified in the Quality Assurance Project Plan. The checks were performed using a Cs-137 button source placed at a fixed location on the detector crystal case.

Meteorological conditions were typical for summer in the vicinity. Temperature variations did not have a significant impact on the RSI detector as it passed all quality control checks.

Scans were conducted during July 23 and 24. The gamma buggy was followed by vehicle to stay within wireless range during operations.

Table 1. Scan Areas (Gamma Buggy)

Scanned Areas on 7/23/19
1st scan: Soil Stockpile, south and adjacent to R&D Building
2nd scan: Southeast Retention Ponds perimeters
Scanned Areas on 7/24/19
3rd scan: Machine Shop and west lawn area between Soil Stockpile and Pond 8
4th scan: Former Basin 2 Pond 1 (south)
5th scan: Former Basin 2 Pond 1 (north)
6th scan: Former Basin 2 Pond 1 (east berm next to river)
7th scan: Former Pond 2

V. Results and Discussion

Figure 2 shows the site areas scanned circled in red. Gross gamma rates at the site were found to vary depending upon location by an order of magnitude and more. The Soil Stockpile just south of the R&D building (#4) was covered in plastic and showed significant relative gamma activity, the maximum being 27 times the background value. The south one third of the pile was capped in what appeared to be clean soil that shielded the material beneath to near background values.

The scans performed at the margins of the South Ponds showed the area to be relatively low, except Pond 8 which is now dry. The west berm and much of Pond 8 itself showed elevated activity with a maximum of 25 times background. Several areas of elevated activity were observed around the Machine Shop (#5) on nearby lawn areas, the highest being 17 times background. Site personnel explained that contaminated soil had been handled for removal at these locations previously. Elevated activities detected around buildings in the vicinity were suspected of resulting from stored waste material contained inside. No buildings were entered during the scans.

No significant activity was found on the former Basin 2 Pond locations. The highest activities were recorded at the Former Pond 2 location which appeared to be backfilled at some point and was in the process of being retrenched for material recovery. Of these the highest activities of 45 times background were found along the length of the trench and appeared to be emanating from the exposed material below. No attempt was made to scan within the trench.

VI. Data Limitations

The scan data provided by this study are gross gamma-ray measurements in the approximately 50 to 3000 keV range. This provides a complete coverage of all likely gamma-ray emitting sources. The measurements are considered qualitative because they are reported as a total value relative to the background measurement (in counts per second) rather than radionuclide concentration values (e.g. activity per mass of soil).

Scans performed at this site were intended as cursory only and intensive coverage was not performed. Lawn areas were scanned in swaths of approximately 20 feet. Scans conducted around the South Ponds and around buildings on the site were single path only.

The location selected for background measurements appeared to be on fill material likely brought in from offsite and has somewhat lower gamma-ray activities relative to the site as a whole. This has the effect of making unimpacted site areas appear somewhat elevated.

VII. References

1. Quality Assurance Project Plan for Scanning Systems Support to the Muskogee, OK Site. DCN: 2019-QAPP-SS-Muskogee, Rev. 00, July 15, 2019.

2. NCRFO Standard Operating Procedure: Operation of the Environmental Radiation Buggy Scanning System RFO-366, Rev. 0, January 31, 2017 (in review).

Figure 1. Fansteel Site Location (Map credit: World Street Map ESRI)

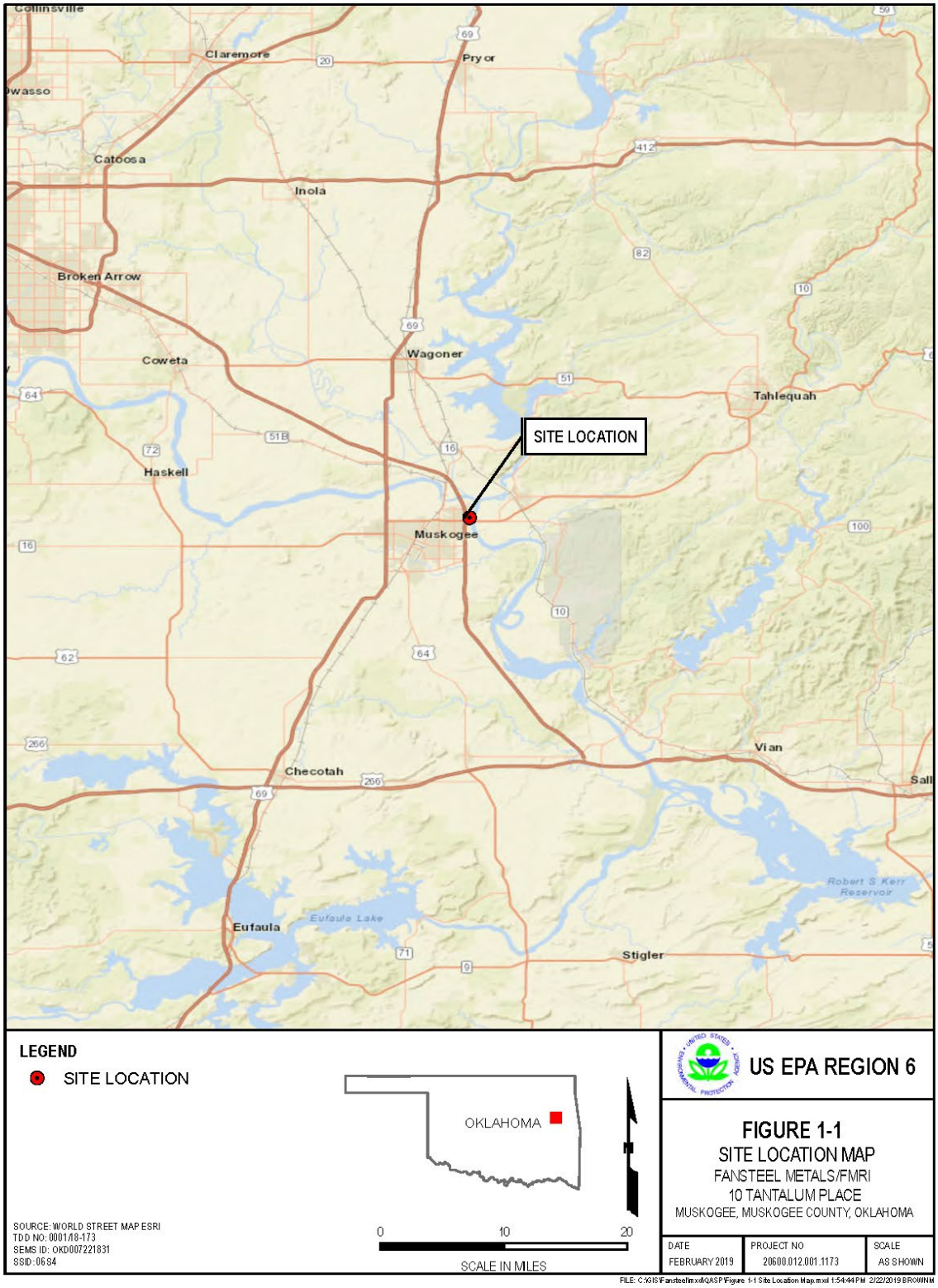

Figure 2. Fansteel Site, Scan Areas (Map credit: World Imagery)